**Mitochondria and cellular energy**

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Found in the cytoplasm, mitochondria are cellular organelles that produce adenosine triphosphate (ATP) near intra-cellular sites where energy is needed. Shape, amount, and intracellular position of mitochondria are not fixed; their movements inside cells are influenced by the cytoskeleton, usually being in close relationship with the energetic demands of each cell type. For instance, cells that have a high consumption of energy (such as muscular, neural, retinal, and gonadic cells) present much greater amounts of mitochondria than those with a lower energetic demand, such as fibroblasts and lymphocytes. Their position in cells also varies, with larger concentrations of mitochondria near the intracellular areas of higher energy consumption. In cells of the ciliated epithelium, for instance, more mitochondria are found next to the cilia. In spermatozoids, they are found in greater amounts next to the initial portion of the flagellum, where the flagellar movement starts.

Mitochondria have their own DNA, RNA (rRNA, mRNA, and tRNA), and ribosomes, and so they are able to synthesize proteins independently from the cell nucleus and the cytoplasm. The internal mitochondrial membrane contains more than 60 proteins. Some of these are enzymes and other proteins that constitute the electron-transporting chain; others constitute the elementary corpuscle rich in ATP-synthetase, the enzyme that promotes the coupling of electron transport to the synthesis of ATP; and finally, there are also enzymes involved in the active transport of substances through the internal membrane.

The main, ultimate result of respiration is the generation of cellular energy through oxidative phosphorylation--ATP formation through the transfer of electrons from nutrient molecules to molecular oxygen. Prokaryotes (such as bacteria) do not contain mitochondria, and the flow of electrons and the oxidative phosphorylation process are associated with the internal membrane of these unicellular organisms. In eukaryotic cells, the oxidative phosphorylation occurs in the mitochondria through the chemiosmotic coupling, the process of transferring protons (H+) from the space between the external and the internal membrane of mitochondria to the elementary corpuscles.

H+ are produced in the mitochondrial matrix by the citric acid cycle and actively transported through the internal membrane to be stored in the inter-membrane space, thanks to the energy released by the electrons passing through the electron-transporting chain. The transport of H+ to the elementary corpuscles is mediated by enzymes of the ATPase family and causes two different effects. First, 50 percent of the transported H+ is dissipated as heat. Second, the remaining hydrogen cations are used to synthesize ATP from ADP (adenosine diphosphate) and inorganic phosphate, which is the final step of the oxidative phosphorylation. ATP constitutes the main source of chemical energy used by the metabolism of eukaryotic cells in the activation of several multiple signal transduction pathways to the nucleus, intracellular enzymatic system activation, active transport of nutrients through the cell membrane, and nutrient metabolization.

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